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# SPACE STATION

## Actions Under Way to Manage Cost, but Significant Challenges Remain



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## Abbreviations

DOD	Department of Defense
GAO	General Accounting Office
NASA	National Aeronautics and Space Administration
OMB	Office of Management and Budget

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United States General Accounting Office  
Washington, D.C. 20548

July 17, 2002

The Honorable Ernest F. Hollings  
Chairman  
The Honorable John McCain  
Ranking Minority Member  
Committee on Commerce, Science,  
and Transportation  
United States Senate

The Honorable Sherwood L. Boehlert  
Chairman  
The Honorable Ralph M. Hall  
Ranking Minority Member  
Committee on Science  
House of Representatives

The National Aeronautics and Space Administration (NASA) has reportedly spent about \$20 billion for developing and operating the International Space Station, but faces many challenges in completing the development of a station that will meet program objectives. The estimated cost to develop the space station has increased by about \$13 billion since 1995 while the schedule has slipped about 4 years. Most recently, the agency revealed that the estimated cost to complete assembly had increased by about \$5 billion—from about \$25 billion to about \$30 billion. This reported cost-growth estimate might not be reliable, however, because NASA does not have good cost-accounting systems or practices.<sup>1</sup>

The estimated cost growth is having a profound effect on the utility of the space station—namely, through substantial cutbacks in construction, the number of crewmembers, and scientific research. Moreover, the severity of these reductions has raised concerns among NASA's international partners and the scientific community about the viability of the program. In view of the concerns surrounding the cost growth, you asked that we (1) identify the reasons for the cost increase and analyze the mechanisms that should have alerted NASA to the cost increase and the need for mitigation plans,

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<sup>1</sup>In response to a legislative mandate, we recently reported that NASA's systems could not provide the data necessary for us to verify amounts obligated for the International Space Station. NASA's independent auditor reported similar problems while attempting to verify costs for the space station that were reported in the agency's fiscal year 2001 financial statements.

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(2) assess the impact of the cost growth on the utility of the U.S. science program, (3) identify the corrective actions planned by NASA, and (4) provide any preliminary observations on the feasibility and status of NASA's actions to mitigate the problem.

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## Results in Brief

Much of the cost growth stemmed from the inadequate definition of requirements, changes in the content of the program, schedule delays that caused the late delivery of the station's elements, and inadequate program oversight. A recent study by the International Space Station Management and Cost Evaluation Task Force concluded that NASA's program plan for executing the fiscal year 2002 through fiscal 2006 budget was not credible because of weaknesses in the program's cost-estimating processes. The task force pointed out that these problems occurred because NASA had not instituted or had ignored many of the program's control and contract oversight mechanisms that should have alerted the agency to the growing cost problem and the need for mitigating actions. For example, NASA did not prepare a life-cycle cost estimate for the station and thus did not use those costs to manage the program. Another contributing factor was NASA's focus on staying within annual budgets instead of managing total costs. According to the cost analysis team that supported the task force, this was perhaps the single greatest factor in the program's cost growth.

The cost growth has severely affected the space station, primarily in terms of the scope and capability of the station for conducting scientific research. As a part of the restructuring, for example, further work and funding for the habitation module and crew return vehicle have been deferred, thus requiring the on-orbit crew to be reduced from seven to three members. This will limit the crewmember hours that can be devoted to research. For example, astronauts will have limited time to be used as subjects in research on the effects of space flight on humans. Additionally, NASA has cut back on the number of facilities available for research from 27 to 20. This will eliminate certain experiments, such as those relating to biotechnology. NASA's international partners and the research communities are not satisfied with these and other reductions in capabilities.

NASA is instituting a number of management and cost-estimating reforms. As a result, we are not making any recommendations in this report. Specifically, the agency is preparing a life-cycle cost estimate, developing a program management plan, and reprioritizing the science program. It intends to reflect the results of these reforms in its budget submission for

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fiscal year 2004. These measures should help to put NASA on a better footing for controlling costs and improving management oversight.

But there are significant challenges to the implementation of such reforms. First, the preparation of the life-cycle cost estimate may be difficult because NASA's financial management system has proven inadequate for tracking space station costs. Although NASA plans to use a tested methodology and trained estimators, the agency will also have to develop accurate, detailed cost data to serve as input to the methodology and a means of comparing the resulting estimates with actual costs when realized. Second, many tasks and studies being undertaken, such as those on long-term operating costs, will not be completed until September 2002, leaving NASA with just a small window of opportunity to incorporate its results into the budget for fiscal year 2004. Third, NASA has not yet reached an agreement with its international partners on an acceptable on-orbit configuration, the sharing of research facilities, and the sharing of cost. It is exceedingly important for NASA to overcome these challenges. Congressional and agency decision makers cannot assess the full impact of the science program's restructuring and make decisions with regard to the direction of the space station program until NASA develops a credible, reprioritized research plan for the core complete station and defines the desired final configuration of the on-orbit station. Moreover, NASA will remain at risk of losing the support of the program's international partners unless it can come to agreement with them on what the station's capabilities will be in light of the reprioritized science program. In its comments on a draft of this report, NASA stated that the report represents the issues and actions taken to address the cost growth. NASA's response is included as appendix I.

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## Background

NASA and its international partners (Canada, Europe, Japan, and Russia) are building the space station as a permanently orbiting laboratory to conduct materials and life sciences research and earth observations and to provide for commercial utilization and related uses under nearly weightless conditions. Each partner is providing hardware and crewmembers and each is expected to share operating costs and use of the station. The program's highest-priority goals are to (1) maintain a permanent human presence in space, (2) conduct world-class research in space, and (3) enhance international cooperation and U.S. leadership through international development and operations of the space station.

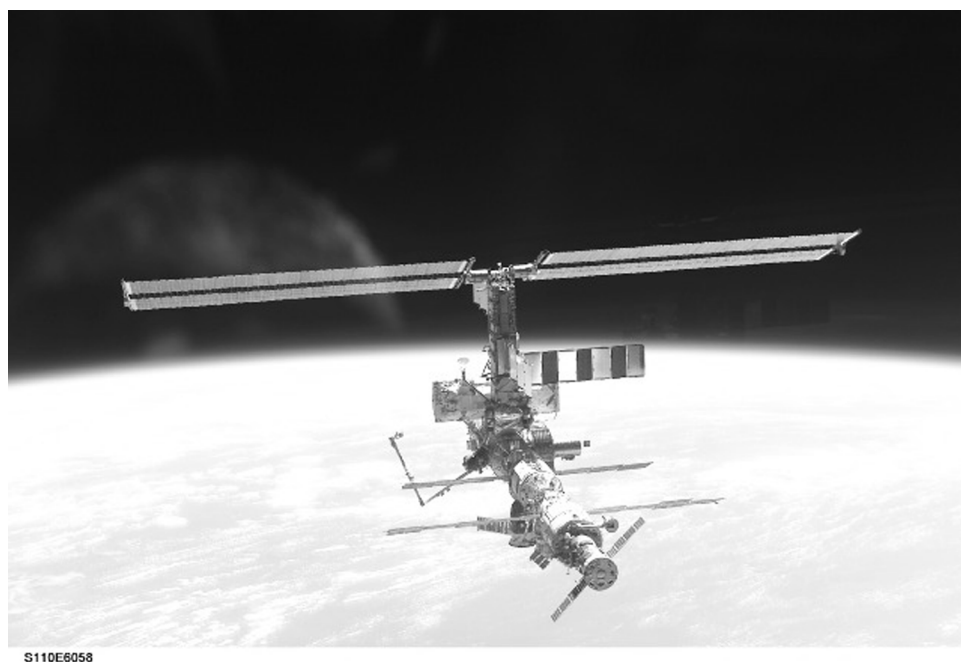


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The technical achievements of the station program have been exceptional. Assembly of the space station began in November 1998 with the launch of the U.S.-funded, Russian-built Zarya module, followed by the launch of the U.S. Unity module in December 1998. The station's occupancy began in October 2000 with the launch of the Expedition I crew. Since then, four other three-person crews have occupied the station while assembly continues. In addition, the crews have been conducting hands-on scientific research. Figure 1 shows the International Space Station on-orbit.

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**Figure 1: International Space Station On-Orbit**



Source: NASA.

Since its inception in 1984, the space station has undergone a number of redesigns and has been mired by cost growth and schedule slips. In January 2001, NASA announced that an additional \$4 billion in funding over the next 5 years would be required to complete the station's assembly and fund its operation. By May 2001 the estimated cost growth had increased to \$4.8 billion. In response to the announcement, the administration directed NASA to take a number of actions, including terminating the propulsion module, deferring the habitation module, deferring the crew return vehicle,

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and reducing funding for scientific research to stay within the President's budget projections.

The President's fiscal year 2002 budget blueprint and budget request for the space station<sup>2</sup> lay out a strategy for containing cost growth that ensures the completion of the U.S. core station and deploys the elements of the program's international partners. To achieve this strategy, NASA was required to construct a plan of action that addressed institutional and program reforms to establish processes for executing the baseline program.

In July 2001, the NASA Administrator appointed the International Space Station Management and Cost Evaluation Task Force to conduct an independent external review and assessment of the station's cost, budget, and management. The Administrator also asked the task force to provide recommendations that could provide maximum benefit to the U.S. taxpayers and the international partners within the President's budget request. The task force reported its findings to the NASA Advisory Council in November 2001.<sup>3</sup>

In response to the task force's recommendations, NASA is undertaking a number of initiatives to restore credibility to the station program. In addition, the Office of Management and Budget (OMB), with input from NASA, is developing criteria that are to be used for measuring progress toward achieving a credible program.

OMB has imposed a 2-year "probation" period on NASA to provide time to reestablish the space station program's credibility. Activities that are to take place during this period include establishing a technical baseline and a life-cycle cost estimate for the remainder of the program, prioritizing the core complete science program, and reaching an agreement with the international partners on the station's final configuration and capabilities. NASA is working toward completing these activities by September 2002 in order to include results in its budget request for fiscal year 2004.

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<sup>2</sup>See *The President's Budget Blueprint: A Blueprint for New Beginnings, a Responsible Budget for America's Priorities* (Feb. 2001).

<sup>3</sup>See *Report by the International Space Station Management and Cost Evaluation Task Force* (Nov. 1, 2001).

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Over the past 8 years, we have performed a body of work that highlighted the space station program's cost growth and weaknesses in cost control. In addition, we have pointed out weaknesses in the agency's financial management system as well as inadequate contract management oversight. Appendix II lists prior GAO reports and testimonies related to the space station program.

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## Reasons for Cost Increases and Mechanisms That Should Have Alerted NASA Management

According to NASA officials, as a consequence of the inadequate definition of requirements, changes in program content, schedule delays, and inadequate program oversight, the estimated development cost of the space station has grown by about \$13 billion since 1995 of which about \$5 billion is attributable to growth since the fiscal year 2001 estimate. However, the agency could not associate specific amounts of the estimated growth with the reasons cited. The program did not utilize available cost control tools to monitor and contain the growth and ignored NASA's guidance in many cases. In addition, because of its focus on managing annual budgets, NASA failed to heed indicators of future cost growth that contributed to the uncertainty regarding the ultimate cost of the space station.

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## Reasons for Cost Growth

One of the major reasons for the cost growth was NASA's inadequate definition of requirements. For example, NASA originally estimated that 500,000 source-lines-of-code of space flight software would be required for the station's operations. However, that estimate has now tripled to 1.5 million lines of code. In addition, NASA assumed that it could rely on computer simulations as opposed to rigorous ground testing to integrate the hardware and software of the various elements. However, program schedule slips permitted additional ground testing, which discovered significant integration problems that escaped notice during the computer simulations. As a result, the program established a more rigorous multielement integrated testing program.

Changes in program content also contributed to the cost growth. A significant item of cost was introduced to the program in 1997 through the addition of the requirement for a crew return vehicle. NASA had planned to use two Russian Soyuz vehicles, each with a maximum capacity of three crewmembers, attached to the station for emergency crew return after achieving permanent six-person crew capability. However, NASA later determined that the Soyuz vehicle did not meet the requirements necessary

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to return an ill or injured crewmember. Thus, the program was modified to require a U.S.-built crew rescue capability for returning seven crewmembers at an estimated total cost of about \$1.5 billion. Also, because of Russian funding problems that delayed the service module's launch, NASA took on an additional development effort in fiscal year 1997 to guard against Russian nonperformance. The actions became collectively known as Russian Program Assurance and included an interim control module and a U.S. propulsion module in the event the Russians could not supply the service module and propellant logistics flights. By February 2001, Russian Program Assurance had added \$1.3 billion in total estimated cost through fiscal year 2006.

Schedule delays increased costs because, at a minimum, fixed costs such as salaries, contractor overhead, and sustaining engineering continued for a longer period than planned. When the space station was redesigned in 1993, NASA established May 1997 as the launch date for the first element and June 2002 as the assembly's completion date. However, the first element was not launched until November 1998. By August 2000, the assembly complete date had slipped to April 2006—a total slip of 46 months. On the basis of NASA's projected spending rate, the program incurred an additional cost of about \$100 million for every month of schedule slippage.

The magnitude of the cost growth began to surface in the spring of 2000 during program operating plan reviews in preparation of the fiscal year 2002 budget request. Following the program operating plan reviews, the program manager ordered a detailed assessment of costs to more specifically determine funding requirements through fiscal year 2006.

Table 1 shows some of the major events leading up to the identification of the space station's cost growth. The table illustrates that the program office did not have a credible cost-estimating capability, as the cost estimate changed and grew as the office continued to uncover additional growth areas.

**Table 1: Major Events Leading to Identification of Cost Growth**

Date	Event	Reported to
May 25, 2000	Program operating plan's review results for fiscal year 2002 show \$3.7 billion of potential areas of cost growth and/or new content in budget rollup.	Johnson Space Center Director and Associate Administrator for Space Flight (NASA headquarters)
July 13, 2000	For fiscal year 2002-2006, Office of Space Flight recommends \$365 million over President's budget for space station for fiscal year 2001.	NASA Capital Investment Council
July 18, 2000	OMB is advised that the space station's budget can accommodate fiscal year 2000 requirements, but that fiscal year 2001 would be "tight" and fiscal year 2002 would see a shortfall against current requirements.	OMB
Oct. 20, 2000	Post-program operating plan cost review indicates program has a \$3 billion-plus funding shortfall through fiscal year 2006.	NASA headquarters
Nov. 9, 2000	NASA advises OMB of potential shortfall of \$2 billion-plus for fiscal year 2002 budget.	OMB
Nov. 27, 2000	Assessment estimate of \$2.2 billion-\$2.4 billion provided to OMB.	OMB
Dec. 15, 2000	NASA presents to OMB a cost estimate that is \$2.7 billion over the fiscal year 2001 budget. NASA commits to complete a "bottom up" review by the end of January 2001.	OMB
Dec. 28, 2000	NASA briefs White House Transition Team and advises the team that the space station's cost increase could range from \$2.5 billion-\$5.0 billion through fiscal year 2006.	White House Transition Team
Jan. 18-19, 2001	NASA's headquarters alerts House and Senate Authorization and Appropriation staffs that cost increase could range from \$2.5 billion-\$3.0 billion.	House and Senate staffs
Feb. 1, 2001	NASA reports to OMB that bottom-up review shows cost growth is \$4.0 billion.	OMB
Mar. 5, 2001	NASA's headquarters briefs House and Senate staffs on results of bottom-up assessment indicating the growth could be as high as \$4.0 billion.	House and Senate staffs
Nov. 7, 2001	OMB Deputy Director testifies before the House Science Committee that, in May 2001, NASA informed OMB that the cost growth number had grown an additional \$800 million to \$4.8 billion.	House Science Committee

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## Mechanisms to Address Cost Growth Were Not Utilized or Were Ignored

NASA has controls in place that should have alerted management to the growing cost problem and the need for mitigating action. These include guidance requiring cost management on a project, and cost and risk modeling capabilities. However, the management and cost evaluation task force and the supporting studies found that NASA did not utilize or ignored many cost control mechanisms because of its focus on fiscal year budget management rather than on total program cost management.

NASA guidance requires that life-cycle cost be estimated, assessed, and controlled throughout a program's life cycle.<sup>4</sup> The estimates are to be prepared to support major program reviews and the development of budget submissions. A handbook instructs cost estimators in selecting a cost model for use in the estimating process and on the proper documentation of the results of the cost analysis.

NASA has considerable cost-modeling capability, including several cost models and information related to the type of costing situations for which they would be appropriate. A study performed by the Rand Corporation for the Office of Science and Technology Policy, which supported the management and cost evaluation task force, noted that NASA has "very good" cost and risk modeling capabilities.<sup>5</sup> However, the study found that the in-house capabilities were not well integrated into the program's planning and management. Because of its short-term budget focus, the program had been reluctant to integrate cost estimation and control practices sufficiently robust to yield confidence in its budget estimates.

The management and cost evaluation task force found that the final space station's cost estimate at completion had not been a management criterion within NASA. According to the task force, because of NASA's focus on executing the program within annual budgets, total cost and schedule became variables. To stay within the annual budget limits, the program's basic content slipped, and total program cost grew. In addition, the cost analysis team that supported the task force cited NASA's culture of managing the program to its annual budgets as perhaps the single greatest factor in the program's cost growth.

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<sup>4</sup>NASA Policy Directive 7120.4B, Program/Project Management and NASA Procedures and Guidelines 7120.5A, NASA Program and Project Management Processes and Requirements.

<sup>5</sup>See *RAND Perspectives on ISS Budget Issues* (Jan. 23, 2002).

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The management and cost evaluation task force made recommendations aimed at restoring cost credibility to the program. Some of those recommendations mirror requirements already contained in NASA guidance, as follows:

- Develop a life-cycle technical baseline to use as the basis for a formal cost estimate.
- Develop a full space station cost estimate using the Department of Defense's (DOD) cost assessment approach, including the use of a cost-analysis requirements document to document the assumptions and results of the cost analysis.
- Prepare an integrated program management plan delineating the work to be accomplished, the work breakdown structure,<sup>6</sup> required resources, and schedules.

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## Impacts on Space Station's Utility

In an effort to mitigate the effects of the large cost growth, NASA reduced planned funding for space station research by about \$1 billion for fiscal years 2002 through 2006. The mitigation actions resulted in significant and perhaps long-term reductions in the scope and capability of the station for conducting scientific research. NASA proposed major changes in the station's design for fiscal year 2001 that resulted in fewer on-orbit scientific facilities, and less research, and limited the crew available for conducting research. The research communities, international partners, and recent studies have raised concerns about the viability of the space station's science program.

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## Baseline Science Program Restructure

The restructured science program will provide fewer facilities needed for conducting scientific research on board the space station. The station's baseline for fiscal year 2001 supported a crew of six to seven astronauts and provided for the outfitting of 27 U.S. research facilities and experiment modules for research in a range of science disciplines. Following the announced cost growth, NASA's Office of Biological and Physical Research, Office of Space Flight, and the space station's Payloads Office at the

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<sup>6</sup>A work breakdown structure is a method of organizing a program into logical subdivisions at lower and lower levels of detail.

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Johnson Space Center initiated a program restructuring activity to align the research program with the on-orbit capabilities and resources available. This activity slowed down selected fiscal year 2001 expenditures to better match the availability of resources for fiscal year 2002 and optimized the scientific utilization of the reduced on-orbit capability. The reduction of content to the revised baseline was not reconciled against standing agreements with the program's international partners.

The budget content for fiscal years 2002 and 2003 for the core-complete station provides for the outfitting of 20 research facilities, known as "racks," leaving about one fourth of the previously planned racks and their utilization unfunded. Some research disciplines were severely affected by the fiscal year 2002 reduction. For example, significant experiments planned to conduct research on materials such as metals, alloys, glasses, and ceramics, and in biotechnology were canceled.

In addition to less hardware for research, there are constraints to utilization of the science facilities principally because the station's crew size will be reduced from a planned seven to three. This will limit the crewmember hours that can be devoted to research. For example, astronauts will have limited time to be used as subjects in research on the effects of space flight on humans. According to NASA officials, crew research hours will be a major limiting factor on the number and complexity of experiments after the arrival of the international partner modules in 2004-2005, particularly constraining research that requires the crew's interaction. NASA officials stated that some crew interaction is required for nearly all space station investigations. These activities include testing, monitoring, sampling, instrument readings, completing questionnaires, and recording results. NASA currently estimates that a minimum of 2.5 crewmembers will be required for maintaining the station, exclusive of their science-related duties during assembly.

NASA had planned that crew time for scientific research would be 100 + hours per week, but the crewmember reduction would limit time to a minimum of 20 hours per week. The 20-hour minimum threshold was established by the space station program manager but has not been met. Table 2 shows NASA's calculation of how the 20 research hours per week would be allocated among the station partners. NASA is looking at ways to mitigate the impact of this reduction.



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**Table 2: Allocation of Research Time Based on a Three-Member Crew**

Partner	Time allocation (percent)	Available hours per week
Russia	38.3	7.7
United States	38.3	7.7
Japan	12.8	2.6
Europe	8.3	1.7
Canada	2.3	0.5

In addition to the funding-driven research cuts cited above, the United States would receive less research capability from an existing major barter arrangement with the Japanese. In return for NASA's launch of the Japanese Experiment Module, Japan is providing the centrifuge accommodation module and centrifuge rotor, which are essential for conducting controlled biological experiments. As a result of technical risk and cost issues associated with the proposed design, NASA accepted a Japanese Space Agency request to reduce the number of science habitats supported from eight to four.

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## Concerns Over Science Restructure

The research communities and international partners are not satisfied with reductions in the space station's capabilities. In the fall of 2000, Congress directed the National Research Council and the National Academy of Public Administration to organize a joint study of the status of microgravity research<sup>7</sup> in the life and physical sciences as it relates to the station. In a late 2001 report, the team concluded that the viability of the overall science program in microgravity would be seriously jeopardized if the space station's capabilities were reduced below fiscal year 2001 levels and there were no annual microgravity research dedicated shuttle flights. The study found that the U.S. scientific community is ready now to use the space station but that this readiness cannot be sustained if (1) proposed reductions in the scientific capabilities occur, (2) slippage continues in both the development and science utilization schedules for the space station, or (3) uncertainties continue in funding for science facilities and flight experiments on the space station. The study observed that readiness

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<sup>7</sup>Research that is concerned with the effects of reduced gravity on physical, chemical, and biological phenomena.

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is beginning to deteriorate and that it will continue to erode with further delays in the completion of the space station. NASA officials stated that the station's international partners have major concerns regarding the uncertainty that NASA will meet its international commitments for the habitation function and crew rescue capability. According to NASA, the partners have stated that a station configuration that provides for only three crewmembers is unacceptable. NASA plans to develop an optional space station configuration and hopefully obtain appropriate U.S. and partner concurrence by November/December 2002.

Several recent studies and NASA's actions highlight concerns regarding the space station's science program. The November 2001 report of the management and cost evaluation task force found that the U.S. core complete configuration as an end-state would not achieve the unique research potential of the space station. A December 2001 NASA Independent Implementation Review found that budget reductions, crew hour limitations, and the realization of other resource constraints have all significantly reduced the anticipated space station research content in terms of quality and quantity. For example, there are fewer flight investigations and tests, and some science disciplines cannot achieve planned program goals. In addition, the scientific community and the international partners have raised concerns. The research reductions, if not mitigated, may jeopardize the scientific community/partner's capacity for conducting high value research.

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## Reforms Are Under Way or Planned

NASA has several institutional and program reforms under way to respond to the management and cost evaluation task force's recommendations and to bring cost-estimating credibility to the space station program. Specifically, the agency is preparing a life-cycle cost estimate, developing a plan to strengthen program management and controls, and reprioritizing the station's science program. NASA is attempting to complete many of these tasks by September 2002 to influence its fiscal year 2004 budget submission.

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## Cost-Estimating and Program Management Reforms

In July 2001, NASA developed a plan that described the actions that the agency believed were required to respond to the President's budget blueprint requirements, defined conditions for closing the actions, and provided for OMB to monitor NASA's progress in implementing the reforms. The plan called for measures to improve cost-management and

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cost-estimating accuracy, such as metrics designed to alert management to pending problems, including an early warning system for potential cost growth, and the establishment of a cost-estimating capability to take advantage of the latest estimating and management tools and techniques.

To strengthen the cost-estimating and control function, the program office is also establishing a management information system and hiring cost estimators. An interim management information system will be used initially, and the permanent system is to be available by March 2003 during the implementation of a key component of the Integrated Financial Management Program at the Johnson Space Center. The program office has the authority to hire 10 estimators, which it plans to use to establish a cost-estimating capability in the station's program office. NASA is in the process of preparing its life-cycle cost estimate using the DOD cost assessment approach and plans to have it completed in early August 2002. An independent team headed by a DOD Cost Analysis Improvement Group official will prepare an independent cost estimate, also scheduled for completion in August 2002. The in-house and independent cost estimates will then be reconciled.

The program office is also developing a plan to strengthen program management and controls. According to NASA officials, cost, schedule, and technical reviews will be implemented to provide the program manager with an early warning of potential problems, such as cost growth and budget overruns. The program will also develop risk analysis tools and improve risk system and cost integration.

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## Science Program Reprioritizing

NASA is also taking steps to reprioritize the science to be performed on the space station. In consultation with the White House Office of Science and Technology Policy and OMB, NASA has assembled an ad-hoc external advisory committee to assist the agency in prioritizing its entire research program, including both station-based research as well as nonstation-based research. Consistent with recommendations from the management and cost evaluation task force, NASA is attempting to place the highest priority on investigations requiring access to the space environment. The scientific community will have representation on the ad-hoc committee and will therefore be involved in helping to reestablish science objectives and improving scientific productivity.

The research advisory committee's charter is to evaluate and validate high-priority science and technology research that will maximize the research

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returns within the available resources. It plans to (1) assess the degree to which key research objectives can or should be addressed by the space station, (2) identify and assess how options among the key research objectives would change if the station remains at the U.S. core-complete configuration or evolves with additional funding, and (3) recommend modification or addition to the Office of Biological and Physical Research's goals and objectives. In addition, the advisory committee will also identify and recommend criteria that can be used to implement specific research activities and programs on the basis of priorities. According to a NASA official, the agency plans to report the advisory committee's findings to OMB in August 2002. The report is to include the prioritized research program and the roadmap to getting there. NASA's goal is to reflect the science research priorities in its fiscal year 2004 budget submission.

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## Challenges Ahead

Successfully completing these initiatives is vitally important, since they are integral to providing Congress and agency decision makers with the information they need to make decisions on the future of the space station. But there are significant challenges facing NASA in completing them.

NASA's milestones provide for almost no slippage. Specifically, the preparation of a reliable life-cycle cost estimate may be difficult because NASA currently lacks a modern integrated financial management system to track and maintain data needed for estimating and controlling costs. Such a system was not available when NASA prepared the \$4.8 billion cost growth estimate and thus the accuracy of that estimate is questionable. The NASA Administrator has established the integrated financial management program as one of his top priorities. The successful implementation of the first major component, the core financial system, by June 2003 is critical to the agency's ability to control costs. In addition, many tasks and studies being undertaken will not be completed until September 2002, leaving NASA with a very short time frame to incorporate its results into the 2004 budget. These include NASA's study and independent validation of life-cycle costs, its assessment of long-and short-term options for increasing the station's crew complement, and its assessment of how research can be maximized with limited deliveries of samples and equipment. (Deliveries would be limited because NASA plans to reduce space shuttle flights from seven to four per year.)

Lastly, NASA has not yet reached agreements with its international partners on an acceptable on-orbit configuration as well as how research facilities and costs should be shared. Such agreements are important not only to

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reach a decision on the end-state of the space station but also to strengthen support of the program's international partners.

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## Conclusion

NASA is at a critical juncture with the space station program. Because of the cost growth, the program is essentially unable to carry out the full intent of its original objectives. This has raised concerns from NASA's international partners. To begin working through this dilemma, NASA must first develop a credible budget for the core-complete station, define a station configuration that will be acceptable to the international partners, and obtain OMB's approval. This is a difficult endeavor in itself, since NASA is facing a highly compressed schedule and does not have an integrated system for estimating and controlling costs. The agency is attempting to use the latest estimating and management tools and techniques but needs accurate, detailed cost data and the ability to compare resulting estimates with actual costs. If NASA cannot succeed with a viable budget for fiscal year 2004, it will jeopardize the opportunity for Congress and the administration to regain confidence in the program.

If NASA *does* succeed with the fiscal year 2004 budget, it still faces considerable challenges with the space station program. In the short run, it must successfully work with its international partners to decide how to best use the resources that remain available to the program. This is a significant challenge because it involves prioritizing research programs for which partners already have a vested interest. Moreover, in the long run, NASA must find ways to make sure that the restructured program stays on track. This not only means making sure that the root causes of problems that have plagued the program are sufficiently addressed, but that any schedule slippage or cost growth is immediately addressed and that oversight mechanisms already in place are vigilantly adhered to.

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## Agency Comments

In written comments on a draft of this report, NASA's Associate Deputy Administrator for Institutions said that the report represents the issues and actions taken to address cost growth. He also stated that other external reviews are scheduled for September 2002 and that continued evaluations by GAO would be appreciated.

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## Scope and Methodology

To determine the reasons for the cost growth, we evaluated previous internal and independent analyses of the space station's cost growth. We also interviewed NASA officials regarding cost estimates and the process by which cost information is studied and communicated throughout NASA.

To assess program oversight mechanisms, we reviewed NASA's policies and procedures governing program management. We also interviewed procurement and program management officials to identify specific tools used in the program's oversight and assessed the extent to which the program relies on contractor inputs to perform its internal cost analyses.

To assess the impacts of cost reduction proposals on the space station's utility, we evaluated the minutes from Space Station Utilization Advisory Subcommittee meetings, along with internal and external studies on the effects of cost reduction proposals on station research activities. In addition, we reviewed a report by the National Research Council related to the research capabilities of the space station. We also interviewed cognizant program officials and officials within the research community.

To accomplish our work, we visited NASA headquarters, Washington, D.C; Johnson Space Center, Texas; and Marshall Space Flight Center, Alabama. We also coordinated our work with independent and NASA-internal teams performing space station program reviews.

We conducted our work from June 2001 through April 2002 in accordance with generally accepted government standards.

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Unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from its issue date. At that time, we will send copies to the NASA Administrator; the Director, Office of Management and Budget; and other interested parties. We will also make copies available to others on request. In addition, the report will be available at no charge on the GAO Web site at <http://www.gao.gov>.

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Please contact me at (202) 512-4841 if you or your staffs have any questions about this report. Major contributors to this report are listed in appendix III.

Sincerely yours,

A handwritten signature in black ink, appearing to read "Allen Li". The signature is fluid and cursive, with the first name "Allen" and the last name "Li" clearly distinguishable.

Allen Li  
Director  
Acquisition and Sourcing Management Team

# Comments from the National Aeronautics and Space Administration

National Aeronautics and  
Space Administration  
**Office of the Administrator**  
Washington, DC 20546-0001



JUN 21 2002

Mr. Allen Li  
Director  
Acquisition and Sourcing Management  
General Accounting Office  
Washington, DC 20548

Dear Mr. Li:

This letter is in response to your correspondence dated May 16, 2002, forwarding your draft report on actions underway to manage cost growth of the International Space Station (ISS) (GAO Code 120076). The report provided for review represents the issues and actions taken to address cost growth. Given the broad set of management and financial actions taken to restore confidence in the ISS Program, and the absence of additional recommendations in the draft report, I hope it is your impression that we are seriously and aggressively addressing our weaknesses.

Initial evaluation of ISS performance against recommendations provided by the ISS Management and Cost Evaluation Task Force and NASA Advisory Council, will be scheduled for September 2002. As NASA considers external audit and advisory groups essential to our success, continued evaluation by the GAO and any future recommendations will be appreciated as we proceed ahead to complete this tremendous laboratory in space.

Cordially,

A handwritten signature in cursive script that reads "Michael D. Christensen".

Michael D. Christensen  
Associate Deputy Administrator  
for Institutions



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# Prior GAO Reports and Testimonies Related to the International Space Station Program

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*NASA: Compliance With Cost Limits Cannot Be Verified.* [GAO-02-504R](#). Washington, D.C.: Apr. 10, 2002.

*NASA: Leadership and Systems Needed to Effect Financial Management Improvements.* [GAO-02-551T](#). Washington, D.C.: Mar. 20, 2002.

*NASA: International Space Station and Shuttle Support Cost Limits.* [GAO-01-100R](#). Washington, D.C.: Aug. 31, 2001.

*Space Station: Inadequate Planning and Design Led to Propulsion Module Project Failure.* [GAO-01-633](#). Washington, D.C.: June 20, 2001.

*Space Station: Russian-Built Zarya and Service Module Compliance With Safety Requirements.* [GAO/NSIAD-00-96R](#). Washington, D.C.: Apr. 28, 2000.

*Space Station: Russian Compliance with Safety Requirements.* [GAO/T-NSIAD-00-128](#). Washington, D.C.: Mar. 16, 2000.

*Space Station: Russian Commitment and Cost Control Problems.* [GAO/NSIAD-99-175](#). Washington, D.C.: Aug. 17, 1999.

*Space Station: Cost to Operate After Assembly Is Uncertain.* [GAO/NSIAD-99-177](#). Washington, D.C.: Aug. 6, 1999.

*Space Station: Status of Russian Involvement and Cost Control Efforts.* [GAO/T-NSIAD-99-117](#). Washington, D.C.: Apr. 29, 1999.

*Space Station: U.S. Life-Cycle Funding Requirements.* [GAO/T-NSIAD-98-212](#). Washington, D.C.: June 24, 1998.

*International Space Station: U.S. Life-Cycle Funding Requirements.* [GAO/NSIAD-98-147](#). Washington, D.C.: May 22, 1998.

*Space Station: Cost Control Problems.* [GAO/T-NSIAD-98-54](#). Washington, D.C.: Nov. 5, 1997.

*Space Station: Deteriorating Cost and Schedule Performance Under the Prime Contract.* [GAO/T-NSIAD-97-262](#). Washington, D.C.: Sept. 18, 1997.

*Space Station: Cost Control Problems Are Worsening.* [GAO/NSIAD-97-213](#). Washington, D.C.: Sept. 16, 1997.

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*NASA: Major Management Challenges.* [GAO/T-NSIAD-97-178](#). Washington, D.C.: July 24, 1997.

*Space Station: Cost Control Problems Continue to Worsen.* [GAO/T-NSIAD-97-177](#). Washington, D.C.: June 18, 1997.

*Space Station: Cost Control Difficulties Continue.* [GAO/T-NSIAD-96-210](#). Washington, D.C.: July 24, 1996.

*Space Station: Cost Control Difficulties Continue.* [GAO/NSIAD-96-135](#). Washington, D.C.: July 17, 1996.

*Space Station: Estimated Total U.S. Funding Requirements.* [GAO/NSIAD-95-163](#). Washington, D.C.: June 12, 1995.

*Space Station: Update on the Impact of the Expanded Russian Role.* [GAO/NSIAD-94-248](#). Washington, D.C.: July 29, 1994.

*Space Station: Impact of the Expanded Russian Role on Funding and Research.* [GAO/NSIAD-94-220](#). Washington, D.C.: June 21, 1994.

# Staff Acknowledgements

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Jerry Herley, James Beard, Fred Felder, Erin Baker, Cristina Chaplain, Belinda LaValle, and John Gilchrist made key contributions to this report.

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